

SEQUENCE LISTING

<110> Kaslow, David C.
Tsuboi, Takafumi
Torii, Motomi
The Government of the United States of America
as represented by the Secretary of the
Department of Health and Human Services

<120> Vaccines for Blocking Transmission of Plasmodium vivax

<130> 015280-34210US

<140> US 09/554,960
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<150> US 60/045,283
<151> 1997-05-01

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<151> 1998-12-04

<160> 24

<170> PatentIn Ver. 2.0

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<220>
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<223> Pvs28

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acttttgcgc ctcccccttg ttcaaa atg aat acc tac cac agc ttg ctg ttc 173
Met Asn Thr Tyr His Ser Leu Leu Phe
1 5

ctt ctg gcc atc gtg ctt act gtt aag cac acc ttc gca aag gtc acc 221
Leu Leu Ala Ile Val Leu Thr Val Lys His Thr Phe Ala Lys Val Thr
10 15 20 25

gcg gag acc caa tgc aaa aat ggc tat gta gtc caa atg agc aat cat 269
Ala Glu Thr Gln Cys Lys Asn Gly Tyr Val Val Gln Met Ser Asn His
30 35 40

ttt gaa tgc aaa tgc aac gac ggg ttt gtt atg gca aat gaa aac act 317
Phe Glu Cys Lys Cys Asn Asp Gly Phe Val Met Ala Asn Glu Asn Thr
45 50 55

tgc gag gaa aaa cgc gat tgc aca aat cca caa aat gta aat aaa aac 365
Cys Glu Glu Lys Arg Asp Cys Thr Asn Pro Gln Asn Val Asn Lys Asn
60 65 70

tgt gga gac tac gct gtg tgt gca aac acc aga atg aat gat gag gaa	413
Cys Gly Asp Tyr Ala Val Cys Ala Asn Thr Arg Met Asn Asp Glu Glu	
75 80 85	
aga gca tta cga tgc ggc tgc ata tta ggg tac acc gta atg aat gag	461
Arg Ala Leu Arg Cys Gly Cys Ile Leu Gly Tyr Thr Val Met Asn Glu	
90 95 100 105	
gtg tgt act cca aat aaa tgt aac ggc gtt ttg tgt gga aag gga aag	509
Val Cys Thr Pro Asn Lys Cys Asn Gly Val Leu Cys Gly Lys Gly Lys	
110 115 120	
tgc atc tta gat ccc gct aat gtg aac agc acc atg tgc tct tgt aat	557
Cys Ile Leu Asp Pro Ala Asn Val Asn Ser Thr Met Cys Ser Cys Asn	
125 130 135	
ata gga acc aca ttg gat gaa tct aaa aaa tgt gga aag cca gga aaa	605
Ile Gly Thr Thr Leu Asp Glu Ser Lys Lys Cys Gly Lys Pro Gly Lys	
140 145 150	
act gaa tgc acg ttg aag tgt aag gca aac gaa gaa tgt aaa gag act	653
Thr Glu Cys Thr Leu Lys Cys Lys Ala Asn Glu Glu Cys Lys Glu Thr	
155 160 165	
cag aat tat tac aag tgc gtt gcg aag gga agc ggc gga gaa ggc agc	701
Gln Asn Tyr Tyr Lys Cys Val Ala Lys Gly Ser Gly Gly Glu Gly Ser	
170 175 180 185	
ggt gga gaa ggc agc ggc gga gag ggc agc ggc gga gag ggc agc ggc	749
Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly	
190 195 200	
gga gag ggc agc ggt gga gac aca gga gca gct tac agt ctc atg aac	797
Gly Glu Gly Ser Gly Gly Asp Thr Gly Ala Ala Tyr Ser Leu Met Asn	
205 210 215	
gga tct gca gta atc agc ata cta ctt gta ttc gcc ttc ttc atg atg	845
Gly Ser Ala Val Ile Ser Ile Leu Leu Val Phe Ala Phe Phe Met Met	
220 225 230	
tca tta gtg tagacgattc tacacacaca cacaacata cacaaggaa	894
Ser Leu Val	
235	
gaagcgtctc acagagtcag ttcaagtcat acgcacaaaa aaggaaagta catccagctg	954
gtgaaaagagc atttatgtgt gcagttatcc ttgggagaag caccctccac ccagttgcgt	1014
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Val Lys His Thr Phe Ala Lys Val Thr Ala Glu Thr Gln Cys Lys Asn
 20 25 30

Gly Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp
 35 40 45

Gly Phe Val Met Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys
 50 55 60

Thr Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys
 65 70 75 80

Ala Asn Thr Arg Met Asn Asp Glu Glu Arg Ala Leu Arg Cys Gly Cys
 85 90 95

Ile Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Asn Lys Cys
 100 105 110

Asn Gly Val Leu Cys Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn
 115 120 125

Val Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Thr Thr Leu Asp Glu
 130 135 140

Ser Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys
 145 150 155 160

Lys Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val
 165 170 175

Ala Lys Gly Ser Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly
 180 185 190

Glu Gly Ser Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp
 195 200 205

Thr Gly Ala Ala Tyr Ser Leu Met Asn Gly Ser Ala Val Ile Ser Ile
 210 215 220

Leu Leu Val Phe Ala Phe Phe Met Met Ser Leu Val
 225 230 235

<210> 3
 <211> 995
 <212> DNA
 <213> Plasmodium vivax

<220>
 <221> CDS
 <222> (255)..(914)
 <223> Pvs25

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 ttgcattgt ttgcttggtt gctttttgc ttattcgccc gttttccgc ttgcccgttc 120
 gccccgtcca caacgcgccc ctgcaaaggt tgcccaccac cgaccacaaa aacttattca 180
 ccaccatccg agcggaaagg aacgcccggc actgtgctgc ctacctcccc gaataacaac 240

tccacttagc caaa atg aac tcc tac tac agc ctc ttc gtt ttt ttc ctc	290
Met Asn Ser Tyr Tyr Ser Leu Phe Val Phe Phe Leu	
1 5 10	
gtc caa att gcg cta aag tat agc aag gca gcc gtc acg gta gac acc	338
Val Gln Ile Ala Leu Lys Tyr Ser Lys Ala Ala Val Thr Val Asp Thr	
15 20 25	
ata tgc aaa aat gga cag ctg gtt caa atg agt aac cac ttt aag tgt	386
Ile Cys Lys Asn Gly Gln Leu Val Gln Met Ser Asn His Phe Lys Cys	
30 35 40	
atg tgt aac gaa ggg ctg gtg cac ctt tcc gaa aat aca tgt gaa gaa	434
Met Cys Asn Glu Gly Leu Val His Leu Ser Glu Asn Thr Cys Glu Glu	
45 50 55 60	
aaa aat gaa tgc aag aaa gaa acc cta ggc aaa gca tgc ggg gaa ttt	482
Lys Asn Glu Cys Lys Glu Thr Leu Gly Lys Ala Cys Gly Glu Phe	
65 70 75	
ggc cag tgt ata gaa aac cca gac cca gca cag gta aac atg tac aaa	530
Gly Gln Cys Ile Glu Asn Pro Asp Pro Ala Gln Val Asn Met Tyr Lys	
80 85 90	
tgt ggt tgc att gag ggc tac act ttg aag gaa gac act tgt gtg ctt	578
Cys Gly Cys Ile Glu Gly Tyr Thr Leu Lys Glu Asp Thr Cys Val Leu	
95 100 105	
gat gta tgt caa tac aaa aat tgt gga gaa agt ggc gaa tgc att gtt	626
Asp Val Cys Gln Tyr Lys Asn Cys Gly Glu Ser Gly Glu Cys Ile Val	
110 115 120	
gag tac ctc tcg gaa atc caa agt gca ggt tgc tca tgt gct att ggc	674
Glu Tyr Leu Ser Glu Ile Gln Ser Ala Gly Cys Ser Cys Ala Ile Gly	
125 130 135 140	
aaa gtc ccc aat cca gaa gat gag aaa aaa tgt acc aaa acg gga gaa	722
Lys Val Pro Asn Pro Glu Asp Glu Lys Lys Cys Thr Lys Thr Gly Glu	
145 150 155	
act gct tgt caa ttg aaa tgt aac aca gat aat gaa gtc tgc aaa aat	770
Thr Ala Cys Gln Leu Lys Cys Asn Thr Asp Asn Glu Val Cys Lys Asn	
160 165 170	
gtt gaa gga gtt tac aag tgc cag tgt atg gaa ggc ttt acg ttc gac	818
Val Glu Gly Val Tyr Lys Cys Gln Cys Met Glu Gly Phe Thr Phe Asp	
175 180 185	
aaa gag aaa aat gta tgc ctt tcc tat tct gta ttt aac atc cta aac	866
Lys Glu Lys Asn Val Cys Leu Ser Tyr Ser Val Phe Asn Ile Leu Asn	
190 195 200	
tac tcc ctc ttc ttt atc atc ctg ctt gtc ctt tcg tac gtc ata	911
Tyr Ser Leu Phe Phe Ile Ile Leu Leu Val Leu Ser Tyr Val Ile	
205 210 215	
taagtgcgaa acttgcgca gctaaggcgcg caaatttttt aagttaaaat acttttcttt	971
actgaactta ccgacttgcg atgt	995

<210> 4
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 <212> PRT
 <213> Plasmodium vivax

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 Leu Lys Tyr Ser Lys Ala Ala Val Thr Val Asp Thr Ile Cys Lys Asn
 20 25 30
 Gly Gln Leu Val Gln Met Ser Asn His Phe Lys Cys Met Cys Asn Glu
 35 40 45
 Gly Leu Val His Leu Ser Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys
 50 55 60
 Lys Lys Glu Thr Leu Gly Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile
 65 70 75 80
 Glu Asn Pro Asp Pro Ala Gln Val Asn Met Tyr Lys Cys Gly Cys Ile
 85 90 95
 Glu Gly Tyr Thr Leu Lys Glu Asp Thr Cys Val Leu Asp Val Cys Gln
 100 105 110
 Tyr Lys Asn Cys Gly Glu Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser
 115 120 125
 Glu Ile Gln Ser Ala Gly Cys Ser Cys Ala Ile Gly Lys Val Pro Asn
 130 135 140
 Pro Glu Asp Glu Lys Lys Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln
 145 150 155 160
 Leu Lys Cys Asn Thr Asp Asn Glu Val Cys Lys Asn Val Glu Gly Val
 165 170 175
 Tyr Lys Cys Gln Cys Met Glu Gly Phe Thr Phe Asp Lys Glu Lys Asn
 180 185 190
 Val Cys Leu Ser Tyr Ser Val Phe Asn Ile Leu Asn Tyr Ser Leu Phe
 195 200 205
 Phe Ile Ile Leu Leu Val Leu Ser Tyr Val Ile
 210 215

<210> 5
 <211> 377
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs25-Pvs28
 fusion protein

<400> 5
 Ala Val Thr Val Asp Thr Ile Cys Lys Asn Gly Gln Leu Val Gln Met
 1 5 10 15

Ser Asn His Phe Lys Cys Met Cys Asn Glu Gly Leu Val His Leu Ser
 20 25 30

Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys Lys Lys Glu Thr Leu Gly
 35 40 45

Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile Glu Asn Pro Asp Pro Ala
 50 55 60

Gln Val Asn Met Tyr Lys Cys Gly Cys Ile Glu Gly Tyr Thr Leu Lys
 65 70 75 80

Glu Asp Thr Cys Val Leu Asp Val Cys Gln Tyr Lys Asn Cys Gly Glu
 85 90 95

Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser Glu Ile Gln Ser Ala Gly
 100 105 110

Cys Ser Cys Ala Ile Gly Lys Val Pro Asn Pro Glu Asp Glu Lys Lys
 115 120 125

Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln Leu Lys Cys Asn Thr Asp
 130 135 140

Asn Glu Val Cys Lys Asn Val Glu Gly Val Tyr Lys Cys Gln Cys Met
 145 150 155 160

Glu Gly Phe Thr Phe Asp Lys Glu Lys Asn Val Cys Leu Ser Gly Gly
 165 170 175

Gly Pro Gly Gly Ala Lys Val Thr Ala Glu Thr Gln Cys Lys Asn
 180 185 190

Gly Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp
 195 200 205

Gly Phe Val Met Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys
 210 215 220

Thr Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys
 225 230 235 240

Ala Asn Thr Arg Met Asn Asp Glu Glu Arg Ala Leu Arg Cys Gly Cys
 245 250 255

Ile Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Asn Lys Cys
 260 265 270

Asn Gly Val Leu Cys Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn
 275 280 285

Val Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Thr Thr Leu Asp Glu
 290 295 300

Ser Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys
 305 310 315 320

Lys Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val
 325 330 335

Ala Lys Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly
 340 345 350

Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp
 355 360 365

Thr Gly Ala Ala Tyr Ser Leu Met Asn
 370 375

<210> 6
 <211> 21
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:sense primer

<400> 6
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<210> 7
 <211> 17
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:vector-specific
 M13 universal primer

<400> 7
 gtaaaaacgac ggccagt 17

<210> 8
 <211> 24
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:internal
 degenerate sense primer

<400> 8
 tcaratgagt rrycattdg aatg 24

<210> 9
 <211> 25
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:PCR-sense
 splinkerette #1 primer

<400> 9
 cgaatcgtaa ccgttcgtac gagaa 25

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<210> 10
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:antisense Pvs25
      specific primer

<400> 10
ggacaagcag gatgataaag                                         20

<210> 11
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:nested PCR
      sense splinkerette #2 internal primer

<400> 11
tcgtaccaga atcgctgtcc tctcc                                         25

<210> 12
<211> 21
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:anti-sense
      Pvs25 specific internal primer

<400> 12
agcacacacaag tgttttcctt c                                         21

<210> 13
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:gene specific
      PCR sense primer

<400> 13
actttcgttt cacagcac                                         18

<210> 14
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:gene specific
      PCR anti-sense primer

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<400> 14
aaaggacaag caggatgata 20

<210> 15
<211> 7
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:flexible linker

<400> 15
Gly Gly Gly Pro Gly Gly Gly
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<210> 16
<211> 186
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Pvs25 fusion
      protein

<400> 16
Glu Ala Glu Ala Ser Ala Val Thr Val Asp Thr Ile Cys Lys Asn Gly
 1           5           10           15

Gln Leu Val Gln Met Ser Asn His Phe Lys Cys Met Cys Asn Glu Gly
 20          25           30

Leu Val His Leu Ser Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys Lys
 35          40           45

Lys Glu Thr Leu Gly Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile Glu
 50          55           60

Asn Pro Asp Pro Ala Gln Val Asn Met Tyr Lys Cys Gly Cys Ile Glu
 65          70           75           80

Gly Tyr Thr Leu Lys Glu Asp Thr Cys Val Leu Asp Val Cys Gln Tyr
 85          90           95

Lys Asn Cys Gly Glu Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser Glu
100          105          110

Ile Gln Ser Ala Gly Cys Ser Cys Ala Ile Gly Lys Val Pro Glu Pro
115          120          125

Glu Asp Glu Lys Lys Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln Leu
130          135          140

Lys Cys Asn Thr Asp Asn Glu Val Cys Lys Asn Val Glu Gly Val Tyr
145          150          155           160

Lys Cys Gln Cys Met Glu Gly Phe Thr Phe Cys Lys Glu Lys Asn Val
165          170          175

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Cys Leu Gly Pro His His His His His His
 180 185

<210> 17
 <211> 205
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs28 fusion
 protein

<400> 17
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 1 5 10 15
 Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp Gly
 20 25 30
 Phe Val Leu Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr
 35 40 45
 Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala
 50 55 60
 Asn Thr Arg Met Asn Asn Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile
 65 70 75 80
 Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Tyr Lys Cys Asn
 85 90 95
 Gly Val Leu Cys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val
 100 105 110
 Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Ser Thr Leu Asp Glu Ser
 115 120 125
 Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys
 130 135 140
 Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala
 145 150 155 160
 Lys Gly Ser Gly Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu
 165 170 175
 Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp Thr
 180 185 190
 Gly Ala Ala Tyr Ser Gly Pro His His His His His His
 195 200 205

<210> 18
 <211> 205
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs28Q130
 fusion protein

<400> 18
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 1 5 10 15

Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp Gly
 20 25 30

Phe Val Leu Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr
 35 40 45

Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala
 50 55 60

Asn Thr Arg Met Asn Asn Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile
 65 70 75 80

Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Tyr Lys Cys Asn
 85 90 95

Gly Val Leu Cys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val
 100 105 110

Gln Ser Thr Met Cys Ser Cys Asn Ile Gly Ser Thr Leu Asp Glu Ser
 115 120 125

Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys
 130 135 140

Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala
 145 150 155 160

Lys Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu
 165 170 175

Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp Thr
 180 185 190

Gly Ala Ala Tyr Ser Gly Pro His His His His His His
 195 200 205

<210> 19
 <211> 169
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs28NCR fusion
 protein

<400> 19
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 1 5 10 15

Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp Gly
 20 25 30

Phe Val Leu Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr
 35 40 45

Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala
 50 55 60

Asn Thr Arg Met Asn Asn Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile
 65 70 75 80

Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Tyr Lys Cys Asn
 85 90 95

Gly Val Leu Cys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val
 100 105 110

Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Ser Thr Leu Asp Glu Ser
 115 120 125

Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys
 130 135 140

Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala
 145 150 155 160

Lys Gly Pro His His His His His His
 165

<210> 20
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 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs25 domain of
 Pvs25-Pvs28 fusion protein

<400> 20
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 1 5 10 15

Ser Asn His Phe Lys Cys Met Cys Asn Glu Gly Leu Val His Leu Ser
 20 25 30

Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys Lys Lys Glu Thr Leu Gly
 35 40 45

Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile Glu Asn Pro Asp Pro Ala
 50 55 60

Gln Val Asn Met Tyr Lys Cys Gly Cys Ile Glu Gly Tyr Thr Leu Lys
 65 70 75 80

Glu Asp Thr Cys Val Leu Asp Val Cys Gln Tyr Lys Asn Cys Gly Glu
 85 90 95

Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser Glu Ile Gln Ser Ala Gly
 100 105 110

Cys Ser Cys Ala Ile Gly Lys Val Pro Asn Pro Glu Asp Glu Lys Lys
 115 120 125

Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln Leu Lys Cys Asn Thr Asp
 130 135 140

Asn Glu Val Cys Lys Asn Val Glu Gly Val Tyr Lys Cys Gln Cys Met
 145 150 155 160

Glu Gly Phe Thr Phe Asp Lys Glu Lys Asn Val Cys Leu Ser
 165 170

<210> 21
 <211> 196
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs28 domain of
 Pvs25-Pvs28 fusion protein

<400> 21
 Ala Lys Val Thr Ala Glu Thr Gln Cys Lys Asn Gly Tyr Val Val Gln
 1 5 10 15

Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp Gly Phe Val Met Ala
 20 25 30

Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr Asn Pro Gln Asn
 35 40 45

Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala Asn Thr Arg Met
 50 55 60

Asn Asp Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile Leu Gly Tyr Thr
 65 70 75 80

Val Met Asn Glu Val Cys Thr Pro Asn Lys Cys Asn Gly Val Leu Cys
 85 90 95

Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val Asn Ser Thr Met
 100 105 110

Cys Ser Cys Asn Ile Gly Thr Thr Leu Asp Glu Ser Lys Lys Cys Gly
 115 120 125

Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys Ala Asn Glu Glu
 130 135 140

Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala Lys Gly Ser Gly
 145 150 155 160

Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly
 165 170 175

Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp Thr Gly Ala Ala Tyr
 180 185 190

Ser Leu Met Asn
 195

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<210> 22
<211> 4
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:sequence added
      to enhance cleavage of alpha factor leader

<400> 22
Glu Ala Glu Ala
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<210> 23
<211> 9
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:sequence added
      to enhance cleavage of alpha factor leader

<400> 23
Glu Ala Glu Ala Glu Ala Glu Ala Lys
  1           5

<210> 24
<211> 6
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:polyhistidine
      tag

<400> 24
His His His His His
  1           5
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